

INFORMATION CIRCULAR 33

Pennsylvania Geological Survey

Fourth Series

**GEOLOGIC INTERPRETATION
OF
AEROMAGNETIC MAP
QUARRYVILLE QUADRANGLE**

by

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**COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF INTERNAL AFFAIRS**

Genevieve Blatt, *Secretary*

TOPOGRAPHIC AND GEOLOGIC SURVEY

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FOREWORD

Southeastern Pennsylvania is an area of extremely varied and complex geology with a long history of mineral production. The list of mineral commodities which this area has yielded at various times is considerable, but iron-ore stands out as the most prominent. Scores of iron mines and furnaces have operated in this area in the past 200 years. With a record of production dating back to Pre-Revolutionary War years, the mine at Cornwall is America's oldest continuously operating iron mine in the United States. The recent development of the large and magnificent Grace Mine at Morgantown is living testimony to the fact that Pennsylvania's metallic mining record is not simply a story of the past. Through modern methods of exploration and research, new mineral resources remain to be found.

The Bureau of Topographic and Geologic Survey of the Department of Internal Affairs is pleased to have participated and cooperated with the U. S. Geological Survey in carrying out an aeromagnetic survey of Southeastern Pennsylvania. This modern exploration technique is particularly well suited to the geologic conditions and to the potential mineral resources of the area; it is an extremely efficient method of acquiring geologic data for a large region. The results of the aeromagnetic survey are being published by the U. S. Geological Survey as a series of aeromagnetic contour maps.

We are pleased to present this publication as a service to the Commonwealth of Pennsylvania. It is hoped that this interpretation and discussion of the aeromagnetic maps will serve as a stimulus for further research and development.

A handwritten signature in dark ink, reading "Genevieve Blatt". The signature is fluid and cursive, with the first name and last name clearly distinguishable.

Genevieve Blatt, Secretary
Department of Internal Affairs

GEOLOGIC INTERPRETATION OF AEROMAGNETIC MAP QUARRYVILLE QUADRANGLE

General Statement

The magnetic contour maps being discussed in this series of publications are the result of a cooperative project of the United States Geological Survey and the Pennsylvania Geological Survey, Department of Internal Affairs. About 10,000 square miles of southeastern Pennsylvania have been covered in this survey, the results of which are being published as individual $7\frac{1}{2}$ -minute quadrangle maps.

This information circular is one of a series intended as a preliminary explanation of the interrelation of distinctive magnetic features with geological conditions in each quadrangle. In many instances unusual magnetic patterns can be explained by geological features which have been mapped and studied in the past. It is hoped that the map viewer will not only be aided by such correlation of data, but that this publication may stimulate exploration and research in those areas where there is at present no known or satisfactory geological explanation for some of the magnetic features which appear on the magnetic contour map. Such exploration and research could directly or indirectly lead to discovery and development of new mineral deposits and would greatly further the basic knowledge of the geology of Pennsylvania.

The magnetic contour lines on the map are lines connecting points of equal magnetic intensity. The shape, position, and spacing of the magnetic lines are due to the combined effects of the earth itself, which is a huge magnet, and to the local variations in the magnetism of the rocks underlying any given area. If only the earth as a large, uniform body were responsible for the magnetic lines, they would be essentially straight and simple. It is the local geology, however, which imparts complexities to the patterns of the magnetic lines. Such complexities or variations from a simple pattern are called anomalies.

Local magnetic effects vary from place to place because the magnetic properties of the respective rocks are not alike or because differences in rock structure from place to place change the magnetism measured at the surface. Rocks which have different kinds or different relative amounts of minerals, particularly iron-bearing minerals, have unlike magnetic properties. In general, the more iron minerals present, the stronger the magnetic effect. The iron oxide mineral, magnetite, has a strong magnetic effect even when present in small quantities; when present in large amounts, magnetite is of economic interest as a possible iron ore.

If in a given area the rocks have been folded or faulted by internal earth forces, the resulting variation in position of the different rocks will be indicated by variation in magnetic readings from place to place. Thus, structural complexities as well as mineral variations may be revealed by the magnetic data. Of particular interest are those magnetic variations or anomalies which are circular or tend to enclose a given area; the implication in such cases is that there is a specific, localized causative factor more or less pin-pointed by such a pattern.

The aeromagnetic survey of southeastern Pennsylvania was carried out with the use of an airborne magnetometer, an instrument towed by a plane. The plane covered the area by flying back and forth along straight, parallel flight lines spaced a quarter mile apart. An attempt was made to maintain an elevation of 500 feet, above the ground so as to eliminate magnetic changes due solely to terrain changes. An airborne magnetic survey has the advantage of eliminating very minor magnetic features on the ground, thus permitting a better evaluation of larger and deeper magnetic phenomena. It should be borne in mind that the instruments which have measured the magnetic effects in these studies are very sensitive and capable of detecting small changes. Proper evaluation of these changes is necessary to distinguish those situations which offer possibilities for economic mineral development from those cases where the information yielded is of more academic interest.

Quarryville Quadrangle
U. S. Geological Survey Aeromagnetic Map G. P. 219

The magnetic pattern displayed on the aeromagnetic contour map of the Quarryville quadrangle shows only a general correlation with the geologic pattern which has been mapped in that area.

The northern half of the aeromagnetic map shows a few very widely-spaced contour lines, indicating rocks of uniform magnetic intensity. The geologic map of the same area shows mainly limestones and dolomites with lesser areas of quartzite and phyllite, all involved in narrow, east-west trending folds.

An area with an irregular contour pattern and small anomalies occurs in the southwest corner and along the southern boundary of the quadrangle. This corresponds with the outcrop pattern of a chloritic variety of Wissahickon schist. The small size and amplitude of the anomalies in this area suggests that no significant iron concentrations are present. The minor magnetic variations, however, do help to delineate the schistosity of the Wissahickon Formation.

This aeromagnetic contour map is dominated by a large east-west trending positive magnetic anomaly in the center of the quadrangle. The anomaly is located 2 miles north of Quarryville, on the boundary between Providence and Eden townships. It is approximately 3 miles long and nearly a mile wide. The anomaly shows a very steep magnetic gradient, with an amplitude of approximately 1300 gammas. This is not a simple anomaly; there are at least two distinct peaks which are separated in such a manner as to suggest two magnetic sources, possibly due to faulting or folding. This complex anomaly occurs over an area of Antietam and Harpers quartz-albite-biotite-chlorite schist located on the nose of an anticline which plunges to the southwest. Cloos notes (1941) that the complexities of metamorphism, lithologic variability and structural complexity makes it impossible to distinguish between these two formations in this area. It has been found, however, that there are varying amounts of magnetite in these Lower Cambrian rocks. Knopf and Jonas (1929) report an attempt to mine a magnetite concentration along Pequea Creek, about 5 miles

west of this particular anomaly. There are several other localities in this region where coarse grains of magnetite have been found concentrated in the Antietam Formation. The sharpness of the magnetic gradient and the sizable amplitude of the anomaly suggest that a concentration of magnetite may be responsible, possibly localized within a layer of the schist. The indications are that the anomaly source is at a shallow depth. It will require further exploration to establish the grade and amount of iron concentration responsible for this interesting anomaly.

Bibliography

- Cloos, Ernst, and Hietanen, Anna (1941), Geology of the "Martic Overthrust" and the Glenarm Series in Pennsylvania and Maryland, Geol. Soc. Amer. Spec. Paper 35.
- Knopf, E. B., and Jonas, A. I. (1929), Geology of the McCalls Ferry-Quarryville District, Pennsylvania, U. S. Geol. Survey Bull. 799.